

39. (New) The switch of ~~Claim~~ 35, wherein each reflective surface is attached such that it is perpendicular to the substrate.

40. (New) The switch of ~~Claim~~ 35, wherein each cantilevered arm is made from a material selected from the group of single crystal silicon, polycrystalline silicon, silicon dioxide, or silicon nitride.

41. (New) The switch of ~~Claim~~ 35, wherein each cantilevered arm is spaced from the substrate by means of an extension of the arm extending substantially vertically from the substrate.

42. (New) The switch of ~~Claim~~ 35, wherein the arms of each pair have different thermal expansion properties.

II. REMARKS

This Application has been carefully reviewed in light of the Office Action mailed December 13, 2001 (Paper #7). At the time of the Office Action, Claims 1-30 were pending in this Application. Claims 1-30 were rejected by the Examiner.

Rejections under 35 U.S.C. §112

Claim 30 has been rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the applicant regards as the invention.

Claim 30 has been cancelled.

Rejections under 35 U.S.C. §103

Claims 1 - 16

Claims 1-16 have been rejected by the Examiner under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,259,835 issued to Xingliang Jing (hereafter "Jing") in view of U.S. Patent No. 6,275,325 issued to Michael J. Sinclair (hereafter "Sinclair").

Claim 1 has been amended to more clearly recite unique features of the actuator. As recited in these claims, the actuator has a cantilevered arm with at least one layer of a different material on one surface of the arm. The arm and the layer are made from materials having different thermal expansion properties. Bending is caused by the expansion difference between the arm and its layer.

One distinctive feature of the present invention is that there is a single actuator for each reflective element. This permits the mirrors to be rigidly attached. Also, the reflective surfaces are attached perpendicular to the substrate.

Figures 6A and 6B illustrate these features of the cantilevered actuator. The accompanying description is on page 14.

In the invention of Sinclair, uses four actuators for each mirror element. Each actuator of Sinclair has two actuator members (Figure 20, elements 222, which is mislabeled as 202, and 224). Bending is caused by the expansion difference of the different lengths of the members. Because each mirror is attached to multiple actuators, each mirror must be attached to its actuators by means of sliding hinges 210.

Claims 2 and 3 are cancelled. Claims 4 - 9 are dependent on Claim 1, and are allowable for the same reasons as Claim 1.

Claims 10 - 16 have been cancelled.

Claims 17 - 30

Claims 17-30 have been rejected by the Examiner under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 6,091,867 issued to Eddie H. Young et al. (hereafter "Young et al.") in view of Sinclair.

Claim 17 has been amended to more clearly recite the features of the cantilevered actuator, as discussed above. Claims 18 and 19 have been cancelled. Claims 20 - 24 are dependent on Claim 17.

Claims 25 - 30 have been cancelled.

New Claims 31 - 42

Claims 31 - 42 are requested to be added. Claims 31 - 34 are dependent on Claims 1 and 17. Claims 35 - 42 are directed to the embodiment of FIGURE 7 and the accompanying description. No searching is required for these claims; the embodiment of FIGURE 7 was the subject of prior Claim 29, now cancelled.

III. CONCLUSION

Applicants appreciate the Examiner's careful review of the application. Applicants have made an earnest effort to place this case in condition for allowance in light of the amendments and remarks set forth above. For the foregoing reasons, Applicants respectfully request reconsideration of the rejections and full allowance of Claims 1, 4-9, 17, 20-24, and 31-42.

Attached is a Transmission of Formal Drawings which replaces the informal drawings that were originally submitted

10

with the application on September 6, 2000. Applicants hereby respectfully submit that the substituted drawings add no new matter.

An extension of one (1) month is requested and a Notification of Extension of Time under 37 C.F.R. § 1.136 with the appropriate fee of \$55.00 is attached herewith.

Attached hereto is a marked-up version of the changes made to the claims by the current amendments. The attached pages are captioned "**Version with Markings to Show Changes Made**".

The Commissioner is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 02-0384 of Baker Botts L.L.P.

If there are any matters concerning this application that may be cleared up in a telephone conversation, please contact Applicants' attorney at 512.322.2634.

Respectfully submitted,

BAKER BOTT S L.L.P.
Attorneys for Applicants



Ann C. Livingston
Reg. No. 32,479

Date: 4/24/02

2001 Ross Avenue, Suite 600
Dallas Texas 75201-2980
512.322.2634

IN THE CLAIMS:

Please amend Claims 1, 4-9, 17, and 20-24, cancel Claims 2-3, 10-16, and 18-19, and add new Claims 31-42, as set out below.

1. (Amended) A system for directing a selected light beam to at least one light beam receptor, said system comprising:

an array of stationary optical fibers, each one of said stationary optical fibers constructed and arranged to conduct one of a plurality of light beams including the selected light beam;

an optical switch fabricated on a substrate, the switch having an array of movable reflective surfaces[, each of said movable reflective surfaces being mounted on a thermal actuator;] , and having a single thermal actuator associated with each reflective surface, each thermal actuator comprising a cantilevered arm having a fixed end attached to the substrate and a free end to which the reflective surface is attached, the arm being made from a material having a thermal expansion property, and the arm having a top surface and a bottom surface with a layer of material having a different thermal expansion property on a portion of at least one of these surfaces;

wherein each reflective surface is attached such that it is substantially perpendicular to the substrate

[whereby the application of electrical or heat energy to one of said thermal actuators will move said movable reflective surface mounted on said thermal actuator into the

VERSION WITH MARKINGS TO SHOW CHANGES MADE

2

path of the selected light beam so that the selected light beam will be directed to the light beam receptor].

Please cancel Claim 2 without prejudice or disclaimer.

Please cancel Claim 3 without prejudice or disclaimer.

4. (Amended) The system [as defined in] of Claim 1, wherein the [system is able to select among beams of light by changing the thermal actuator to which electrical or heat energy is directed] cantilevered arm has an air gap between its top and bottom surfaces.

5. (Amended) The system [as defined in] of Claim 1, wherein each [one of the array of stationary optical fibers includes a collimating lens for directing the light beam toward said movable reflective surface] cantilevered arm is made from a material selected from the group of single crystal silicon, polycrystalline silicon, silicon dioxide, or silicon nitride.

6. (Amended) The system [as defined in] of Claim 1, wherein the [selected light beam is directed to a collimating lens on the receptor] arm has a layer on each of the top and bottom surfaces and these layers have the same thermal expansion property.

7. (Amended) The system [as defined in] of Claim 1, wherein [said thermal actuator is a silicon-based beam sandwiched between two layers of a material having a differing coefficient of thermal expansion] the arm has a layer on each

VERSION WITH MARKINGS TO SHOW CHANGES MADE

3

of the top and bottom surfaces and these layers have different thermal expansion properties.

8. (Amended) The system [as defined in] of Claim 1, wherein [said thermal actuator is a silicon-based beam attached to a single layer of a material having a differing coefficient of thermal expansion] the layers are made from a metallic material.

9. (Amended) The system [as defined in] of Claim 1, wherein [said thermal actuator includes a silicon wafer, a sacrificial layer, a material with a first coefficient of thermal expansion, and a material with a second coefficient of thermal expansion] each cantilevered arm is spaced from the substrate by means of an extension of the arm extending substantially vertically from the substrate.

Please cancel Claim 10 without prejudice or disclaimer.

Please cancel Claim 11 without prejudice or disclaimer.

Please cancel Claim 12 without prejudice or disclaimer.

Please cancel Claim 13 without prejudice or disclaimer.

Please cancel Claim 14 without prejudice or disclaimer.

Please cancel Claim 15 without prejudice or disclaimer.

Please cancel Claim 16 without prejudice or disclaimer.

17. (Amended) A thermally operated optical switch for use in directing a beam of light to at least one receptor, said thermally operated optical switch comprising:

a substrate;

VERSION WITH MARKINGS TO SHOW CHANGES MADE

4

[a plurality] an array of reflective surfaces [arrayed in a first position substantially parallel to the beam of light]; and

a plurality of [energy sensitive flexible] cantilever [beams] thermal actuators, each [one of the plurality of flexible] cantilever [beams] actuator [being affixed] having a fixed end affixed to the substrate and having a free end to which an associated reflective surface is attached such that each reflective surface has a single associated actuator [to a corresponding one of said plurality of reflective surfaces], and wherein each actuator has a cantilevered arm made from a material having a thermal expansion property, each arm having an upper surface and a lower surface and having a layer of material having a different thermal expansion property on a portion of at least one of these surfaces;

wherein each reflective surface is attached such that it is substantially perpendicular to the substrate

[wherein a selected energy sensitive flexible cantilever beam is constructed and arranged to bend a selected one of the plurality of reflective surfaces into a second position intersecting the light beam when connected to an energy source, whereby when said selected reflective surface is in said second position the light beam may be reflected to a receptor by the selected reflective surface which is caused to bend by the selected energy sensitive flexible cantilever beam].

Please cancel Claim 18 without prejudice or disclaimer.

Please cancel Claim 19 without prejudice or disclaimer.

5

VERSION WITH MARKINGS TO SHOW CHANGES MADE

20. (Amended) The thermally operated optical switch [as defined in] of Claim 17 wherein [said energy sensitive flexible cantilever beam is a silicon-based beam sandwiched between two layers of a material having a differing coefficient of thermal expansion] cantilevered arm has an air gap between its top and bottom surfaces.

21. (Amended) The thermally operated optical switch [as defined in] of Claim 17 wherein [said energy sensitive flexible cantilever beam is a silicon-based beam attached to a single layer of a material having a differing coefficient of thermal expansion] each cantilevered arm is made from a material selected from the group of single crystal silicon, polycrystalline silicon dioxide, or silicon nitride.

22. (Amended) The thermally operated optical switch [as defined in] of Claim 17 wherein [said energy sensitive flexible cantilever beam includes a silicon wafer, a sacrificial layer, a material with a first coefficient of thermal expansion, and a material with a second coefficient of thermal expansion] the arm has a layer on each of the top and bottom surfaces and the layers have the same thermal expansion property.

23. (Amended) The thermally operated optical switch [as defined in] of Claim 17, wherein [said energy sensitive flexible backing includes a pair of substantially parallel dielectric structural layers separated by an air layer, each of said substantially parallel dielectric structural layers including a conducting layer] the arm has a layer on each of

VERSION WITH MARKINGS TO SHOW CHANGES MADE

6

the top and bottom surfaces and the layers have different thermal expansion properties.

24. (Amended) The thermally operated optical switch [as defined in] of Claim 17 wherein [said energy sensitive flexible beam includes a two substantially parallel cantilevered mounted arms, each of said two substantially parallel cantilever mounted arms having a different current density when connected to a source of electrical energy] the layers are made from a metallic material.

Please cancel Claim 25 without prejudice or disclaimer.

Please cancel Claim 26 without prejudice or disclaimer.

Please cancel Claim 27 without prejudice or disclaimer.

Please cancel Claim 28 without prejudice or disclaimer.

Please cancel Claim 29 without prejudice or disclaimer.

Please cancel Claim 30 without prejudice or disclaimer.

Please add Claims 31 - 42 as follows:

31. (New) The system of Claim 1, wherein the application of electrical or heat energy to one of said thermal actuators will move said reflective surface into the path of the selected light beam so that the selected light beam will be directed to the light beam receptor.

32. (New) The system of Claim 1, wherein the reflective surface is rigidly attached to the arm.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

7

33. (New) The system of Claim 17, wherein the application of electrical or heat energy to one of said thermal actuators will move said reflective surface into the path of the selected light beam so that the selected light beam will be directed to the light beam receptor.

34. (New) The system of Claim 17, wherein the reflective surface is rigidly attached to the arm.

35. (New) A thermally operated optical switch for use in directing a beam of light to at least one receptor, said thermally operated optical switch comprising:

a substrate;

an array of reflective surfaces; and

a plurality of cantilever actuators, each actuator having a pair of arms, each arm of the pair having a fixed end affixed to the substrate and having a free end to which an associated reflective surface is rigidly attached such that each reflective surface has a single associated actuator.

36. (New) The switch of Claim 35, wherein the arms of each pair have different widths.

37. (New) The switch of Claim 35, wherein the arms of each pair have different lengths, such that one arm of each pair is located under the other arm of that pair.

38. (New) The switch of Claim 35, wherein each reflective surface is attached such that it is parallel to the substrate.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

39. (New) The switch of Claim 35, wherein each reflective surface is attached such that it is perpendicular to the substrate.

40. (New) The switch of Claim 35, wherein each cantilevered arm is made from a material selected from the group of single crystal silicon, polycrystalline silicon, silicon dioxide, or silicon nitride.

41. (New) The switch of Claim 35, wherein each cantilevered arm is spaced from the substrate by means of an extension of the arm extending substantially vertically from the substrate.

42. (New) The switch of Claim 35, wherein the arms of each pair have different thermal expansion properties.